**LABORATORY REPORT**

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| **IODIMETRIC TITRATION of VITAMIN C** |
| |  |  | | --- | --- | | Name: | Victor Kwansa | | Index Number: | 2841708 | | Class: | A.1.2.3 | | Demonstrator: | Mrs. Nancy Oppong | | Date: | 24th March, 2009 | |
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| **AIMS/OBJECTIVES:**   1. To determine the amount of ascorbic acid content in vitamin C using iodimetic titration. 2. To determine the weight percent of vitamin C (ascorbic acid) in a commercial tablet using redox titration. 3. To determine and observe the colour changes that would occur during the experiment. 4. To be able to write out the equations of the various reactions that occurred in the experiment. |
| **INTRODUCTION/THEORY:**  Titrations with a standard solution of iodine are referred to as the direct iodimetric titration method (sometimes termed iodimetry).  I2 (solid) + 2e ----------- 2I-  The above equation refers to a saturated aqueous solution of iodine.  In this experiment, redox titration will be used to determine the weight percent of vitamin C (ascorbic acid) in a tablet form.  The titration of a reducing agent (ascorbic acid) with iodine (I2, generally present as I3- ion) to produce an iodide ion (I-) is referred to as an iodimetric titration.  A known amount of I2 (or I– 3) will be generated by adding an excess of solid potassium iodide to a known volume of acidified standard potassium iodate (KIO3) solution.  **IO3 - + 5I- + 6H+ 🡪 3I2 + 3H2O**  excess  The generated I2 is reacted with limited amount of ascorbic acid.  **C6 H8 O6 + 2 H2O + I2 🡪 C6 H6 O6 + 2I - + 2H3O +**  Ascorbic acid excess  (Vitamin–C)  Finally, the excess iodine is back-titrated with sodium thiosulphate (Na2S2O3) solution that was already standardized.  **I2 + 2S2O32- 🡪 2I- + S4O6 2-**  Tetrathionate ion  The amount of ascorbic acid is determined by the stoichiometry of the reaction and the difference between the total amount of I2 present and the amount of I2 that was left over after reaction with ascorbic acid and hence reacted with thiosulphate. |
| **CHEMICALS & EQUIPMENT:**  1. 2ml of Starch indicator  2. 0.05g of Na2CO3  3. 1 g of KIO3  4. 2g of solid KI  5. 10ml of 0.5 M H2SO4  6. 3.45g of Vitamin C  7. 0.3 M H2SO4  8. 4.35 g of Na2S2O3.5H2O |
| **PROCEEDURE:**   |  |  | | --- | --- | | TEST | OBSERVATION | | 1. 4.35g of solid Na2S2O3 was weighed in a beaker. |  | |  |  | | 2. 250ml of freshly prepared boiled water was measured into the 250ml volumetric flask containing 0.05g of Na2CO3. |  | |  |  | | 3. The solid Na2S2O3 was dissolved in the 250ml boiled water containing the 0.05g Na2CO3. |  | |  |  | | 4.0.5g of solid KIO3 was weighed and dissolved in distilled water and topped up to the 250ml mark of the volumetric flask. |  | |  |  | | 5.50ml of KIO3 solution was pipette into a conical flask. |  | |  |  | | 6.2g of solid KI and 10ml of 0.5M H2SO4 were added to the solution and immediately titrated with the thiosulphate solution. | -The solution turned reddish orange.  -After titration, the solution turned pale yellow. | |  |  | | 7. 2ml of starch indicator was added to the solution and titrated with the remaining thiosulphate solution. | -The solution turned blue black on adding the starch indicator.  -The bluish solution lost its colour after the titration. | |  |  | | 8. The titration was repeated with two additional 50ml volumes of KIO3 solution. |  | |  |  | | 9. 0.5g of solid vitamin C tablet was weighed and dissolved in 60ml of 0.3M H2SO4 solution. |  | |  |  | | 10. 2g of solid KI and 50ml of standard KIO3 was added and titrated with the 2ml starch added thiosulphate solution, just before reaching the end point. |  | |
| **CALCULATIONS:**  TITRATION TABLE   |  |  |  |  | | --- | --- | --- | --- | | Burette reading/cm3 | 1 | 2 | 3 | | Initial reading | 0.00 | 0.00 | 0.00 | | Final reading | 42.10 | 42.00 | 42.00 | | Titre value | 42.10 | 42.00 | 42.00 |   Average titre  42.10+42.00+42.00 = 42.03cm3  3  Titration reactions:  IO3- + 5I- + 6H+  3I2 + 3H2O  I2+ 2S2O32-  2I-+ S4O62-  C6H8O6+ I2 + 2H2O  C6H6O6 + 2I+ 2H3O+  n( IO3-) = 1  n(I2) 3  n(I2) = 3 x n(IO3-)  n(I2) = 3 x C(IO3-) x V(IO3-)  n(I2) = 3 x 0.01M x 0.25dm3  n (I2) = 7.5 x 10-3 mol  **I2 + 2S2O3-2** → **2I- + S4O6-2**  n( I2 ) = 1  n(S2O3-2) 2  n (S2O3-2) = 2 x n(I2)  n (S2O3-2) = 2 x 7.5 x10-3 =1.5 x 10-2 mol.  C6H8O6 + 2H2O + I2 ---------- C6 H6O6 + 2I- + 2H3O+    n (I2) = 1  n(C6 H8 O 6 )  1  n( C6H806) = C(C6 H8 O 6) x V(C6 H8 O 6)  m(C6H8O8) = 3.45g  v(C6H8O8) = 60ml = 0.06dm3  Mass density of C6 H8 O 6 = mass/volume = 3.45g/0.06dm3 = 57.5g/dm3  Molar concentration = (mass concentration) / Molar mass  Molar mass of C6H8O6 = 6(12) + 8(1) + 6(16) = 176g/mol  Molar concentration = 57.5/ 176 = 0.3267M  **For first titration**  n (I2) = C(C6 H8 O 6) x V(C6H8O 6)  = 0.3267 x 0.0421 = 1.38 x 10-3 mol  moles of I3- that reacted with C6H8O6 = mol S2O32- - mol of I3- added= (1.5 × 10-2) - ( 1.38×10-3)  = 1.25×10-3mol  Mass of C6 H8 O 6 = n(C6 H8 O 6) x M(C6 H8 O 6) = (1.25×10-3mol × 176) = **0.22g**    **For second titration**  n (I2) = C(C6 H8 O 6) x V(C6H8O 6)  = 0.3267 x 0.042 = 1.37 x 10-3 mol  moles of I3- that reacted with C6H8O6 = mol S2O32-– mol I3- added = (1.5 x10-2 ) - ( 1.37 x 10-3)  =1.279×10-3mol  Mass of C6 H8 O 6 = n(C6 H8 O 6) x M(C6 H8 O 6)  m(C6H8O6 ) = (1.279 x 10-3 x 176) = **0.23g**  **For third titration**  n (I2) = C(C6 H8 O 6) x V(C6H8O 6)  = 0.3267 x 0.042 = 1.37 x 10-3 mol  moles of I3- that reacted with C6H8O6 = mol S2O32-– mol I3- added = (1.5 x10-2 ) - ( 1.37 x 10-3)  =1.279×10-3mol  Mass of C6 H8 O 6 = n(C6 H8 O 6) x M(C6 H8 O 6)  m(C6H8O6 ) = (1.279 x 10-3 x 176) = **0.23g**     |  |  |  |  |  | | --- | --- | --- | --- | --- | | Mass(X)/g | Frequency(f) | fx | (X-X) | (X-X)2 | | 0.22 | 1 | 0.22 | -7 x 10-3 | 4.9 x 10-5 | | 0.23 | 1 | 0.23 | 3 x 10-3 | 9.00 x 10-6 | | 0.23 | 1 | 0.23 | 3 x 10-3 | 9.00 x 10-6 | |  | ∑ƒ = 3 | ∑ƒx = 0.68 |  | ∑ƒ(X-X)=6.7×10-6 |   Mean (X) = ∑ƒx = 0.22+0.23+0.23 = 0.227g  ∑ƒ 3  Standard deviation (S) =  = = 4.73 x 10-3  Relative standard = 4.73×10-3 ×100**%**  0.227  = **2.08%** |
| **DISCUSSION:**  A redox titration was used to determine the weight percentage of vitamin C (ascorbic acid) in the tablet.  The standard deviation was 4.73 x 10-3 whilst the relative standard deviation of vitamin-c was 2.08%.    This deviation is very negligible since it highly approximates the amount of vitamin-c in the tablet.    The deviation may be accounted for in the slight inaccuracy in titre values.    The titration was also immediately taken after pipetting to ensure that the freshly boiled water remained in its most pure and fresh state for the titration. |
| **ERROR ANALYSIS:**   1. During the top up to the 250ml mark on the volumetric flask, the expected amount of distilled water which was needed was slightly exceeded thus; a slightly higher volume of the solution was prepared. 2. The solid vitamin C tablet dissolved in the remaining water droplets in the flask as a result of the washing thus; a slightly diluted vitamin C sample was used. |
| **PRECAUTIONS:**   1. On reaching the end point of the titration, the rate of titrating was reduced in order to ensure that the exact end point was reached. 2. The temperature of the water was slightly kept over normal room temperature to ensure that water remained freshly boiled. 3. All the apparatus were washed clean after every titration to ensure that there were no impurities left for the next experiment. 4. Volume readings were all taken from the end of the meniscus to avoid parallax error. |
| **CONCLUSION:**  In conclusion, the estimation of vitamin C in the solid tablet was very precise from the negligible standard deviation obtained. |
| **REFRENCES:**  -J.P Sevengor, INTRODUCTORY CHEMISTRY  - ***The Columbia Electronic Encyclopedia***, Sixth Edition, Copyright © 2003, Columbia University Press. Licensed from Columbia University Press.  - http://www.answers.com/topic/iodimetry |